EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	960	(705/44).CCLS.	US-PGPUB; USPAT	OR	OFF	2008/08/27 17:23
L2	976	(705/44).CCLS.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2008/08/27 17:23
L3	707	(705/67).CCLS.	US-PGPUB; USPAT	OR	OFF	2008/08/27 17:24
L4	707	(705/67).CCLS.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2008/08/27 17:24
L5	4560	(235/380).CCLS.	US-PGPUB; USPAT	OR	OFF	2008/08/27 17:24
L6	5309	(235/380).CCLS.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2008/08/27 17:24
L7	3820	(235/379).CCLS.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2008/08/27 17:26
L8	2843	(235/379).CCLS.	US-PGPUB; USPAT	OR	OFF	2008/08/27 17:26
L9	3067	(713/1).CCLS.	US-PGPUB; USPAT	OR	OFF	2008/08/27 17:26
L10	3070	(713/1).CCLS.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2008/08/27 17:26
L11	1565	(713/182).CCLS.	US-PGPUB; USPAT	OR	OFF	2008/08/27 17:27

EAST Search History

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L13	1029	(726/1).CCLS.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2008/08/27 17:27
L14	1029	(726/1).CCLS.	US-PGPUB; USPAT	OR	OFF	2008/08/27 17:28
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L17	108	2 and (author$ adj code)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2008/08/27 17:30
L18	41	3 and (author$ adj code)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2008/08/27 17:30
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L20	319	5 and (author$ adj code)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2008/08/27 17:30

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L27	41	12 and (author$ adj code)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2008/08/27 17:34

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[redacted] Dialog Search

Search Strategy

No.	Database	Search term	Results
1	EEDD	calculat$ WITH authoriz$ ADJ code	0
2	EEDD	(calculate OR calculating) WITH authorization ADJ code	0
3	EEDD	authorization ADJ code	4

all counted → [redacted]

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DIALOG

Table of Contents

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Abstract
Telemanagement vendors claim that their products equip voice and data systems managers to react more quickly to changes, provide the highest possible level of service, consolidate their resources, and report on the company's and the manager's success in managing their telecom resources. About 150 suppliers sell nearly 600 telemanagement products and services in the US today. The wide availability of off–the–shelf, general–purpose software for database management has enabled telemanagement suppliers to speed development of new or improved software and to focus on the telecom management aspects of their products. Most telemanagement products and systems are the 270 call accounting–related systems, services, and devices. Until recently, the large, well–known firms have shown little interest in the business of providing telecom management systems, software, and services. Now, however, PBX manufacturers are becoming more active in offering telemanagement products, and dozens of small competitors in the industry have developed niche products.

Full text

In recent years, specialized software and systems have been developed for professional and novice telecom network managers to enable them to perform their daily duties more efficiently and effectively. Telemanagement vendors claim that their products equip voice and data systems managers to react more quickly to changes; to provide the highest possible level of service; to consolidate their resources; and to report on the company's––and the manager's––success in managing their telecom resources.

About 150 suppliers sell nearly 600 telemanagement products and services in the U.S. today. Applications include call accounting, equipment inventory, cable management, PBX/Centrex administration, invoice reconciliation, alarm monitoring, directory and message center, work order processing, trouble reporting, incoming call center management, network design, and a new category: fraud

prevention.

The wide availability of off-the-shelf general-purpose software for data base management, ad hoc reporting, graphic displays, and computer-aided design has enabled telemanagement suppliers both to speed development of new or improved software and to focus on the telecom management aspects of their products. Before these third-party packages were available to them, telecom developers had to write **code** for both their application (e.g., equipment inventory, cable configuration) and the underlying data crunching (e.g., data base and CAD).

Some systems provide these functions individually; others promise to deliver (or are working toward) an integrated entity. Several trends and selected announcements indicate what users should look for in products and services over the next few years.

Windows 3.0. The best-selling software package in history, Windows 3.0 from Microsoft Corp. is rapidly changing the face of the telemanagement industry. Windows can provide telemanagement systems with as many as four important advantages over other PC-based telemanagement systems. (The early versions of some software running under Windows 3.0 might not take advantage of all Windows capabilities. While virtually all MS-DOS applications can operate in "standard mode" in a "DOS Window, " Windows 3.0 provides little or no advantage for users running non-Windows programs.)

The main advantage Microsoft claims for Windows is its GUI, which makes complicated telemanagement software easier to use than traditional menu-based systems. Second, Windows' dynamic data exchange lets users share information with other Windows applications, both from the same telemanagement developer and from others, so the telecommunications data can be customized using spreadsheets, word processors, and other packages. Third, on an 80386 or 80486 PC, Windows is multitasking, enabling the system to process more than one report at a time, or allowing polling or report generation in the background while other applications are being used. Fourth, Windows lets users directly access up to 16 MB of RAM to process large amounts of data.

More than a dozen telemanagement firms admit that they are rewriting their software to operate under Windows 3.0 or 3.1 (scheduled to be released this month). A few others are writing applications to operate on Microsoft's similar OS/2 operating system, which supports IBM's product line.

Systems Reliability Inc.'s ORBi-TEL Telemanagement for Windows and MDR Telemanagement Ltd.'s Telemanagement for Windows are the first announced call accounting packages to take advantage of the popular new computing environment. They can poll and process for up to seven sites or reports simultaneously. Directory, centralized data collection, equipment and cable inventory, and work order management modules for these products are set to be released soon.

Network Design and Analysis Corp. (NDAC) introduced its Autonet Version 2.0 last July. It is the first Windows network design package and provides onscreen network configurations for point-to-point and/or multipoint networks. NDAC claims that the software has been tested for as many as 15,000 network locations, combining private-line analog and digital services, including digital data service, T1, and fractional T1, T2, T3, and the Accunet Spectrum of Digital Services.

Telco Research Corp. took a different approach to its first Windows product. Its CCO System Workstation is PC software that acts as a

terminal to Telco's mainframe telemanagement applications. To simpify access to applications, the work orders, equipment inventory, bill verification, cable management, and other applications appear as icons on the PC screen.

Fraud prevention. Long distance toll fraud--the theft of a company's long distance services--is now a major problem for business telephone customers across the U.S. The main problem isn't the rip-off of calls using phone company calling cards, which carriers can often be persuaded to absorb. It's access using voice mail systems or the direct inward system access (DISA) feature of a PBX.

After observing callers at public pay telephones, the criminals use PCs to probe the telephone switches for long distance **authorization** codes. They sell these codes to computer hackers, drug dealers, and others. Carriers make customers pay for DISA calls, which are made by dialing through customers' PBXs using an **authorization code.** Toll thieves can ring up thousands of dollars of calls over a weekend, and most customer systems are completely unable to detect this activity until it's too late.

Several telemanagement firms have introduced services, software, and a device designed to minimize or stop this problem. Moscom Corp.'s VoiceLock is the only device that claims to be able to stop the problem in most cases. Employing patented voice recognition technology, the device first asks callers to dial in an **authorization code,** then to speak a personal password. The system compares the caller's voice to a voice print on file before allowing the call to proceed. Moscom claims that the entire transaction takes 8 to 18 seconds, which is comparable to the time a typical DISA call takes to set up.

Telco's TRU System Toll Fraud Detector is PC software. It puts out a set of daily reports that summarize activity during the previous day, evening, or weekend for all or selected trunks, extensions, and/or destinations. The software also has a feature that generates random **authorization** codes to frustrate hackers trying to guess additional valid codes. The company provides a free toll-fraud minicourse, which recommends that the software be set so that reports are printed in time for a network manager's arrival each morning.

AAC Corp.'s Toll Fraud Monitoring Service and Telecom Services Ltd.'s Fraud-Chek service are extensions of the call accounting service bureau offerings that these companies provide. The service bureaus poll call record storage devices connected to customer PBXs, process the data to identify records that could indicate fraudulent use, and print specialized accounting reports that can be used to identify the source of calls. Both firms work with their clients to implement new security arrangements, such as procedures for reprogramming the DISA feature and deleting **authorization** codes for employees who leave their firms.

Without these systems, a user's only option is to shut off the DISA feature and require its employees to use long distance carrier calling cards, which can add as much to two dollars to the cost of each phone call.

The search for integration. The search continues for a unified, linked, or integrated system that requires a user to enter data only once. The concept is simple: a single point of entry exists for any information related to telecommunications and data communications, equipment, cables, vendors, users, and services. Users have been asking telemanagement vendors to do this ever since on-site systems became

possible. Now they're demanding this capability.

Telecom managers ask: "If I've told my equipment inventory (or work order) system to add a telephone here, on that date, using the type of equipment, why can't the cable management system be consulted for a couple pairs, the call accounting system crank up automatically, and the on-line directory be brought up to date?"

The benefits of this approach are significant: reduction in hours required to organize data; faster response to service requests; lower costs because of reduced planning time required; and more accurate cost-allocation reports.

Although such integrated products are available for high-end systems, they are still rare for most other systems. Some of the lower-end systems share certain data between programs, but there's usually some data--a name, price, serial number, or quantity--that must be manually keyed in to several systems or modules.

Vendors of mainframe and minicomputer software were the first to supply these integrated systems, which cost $50,000 to $500,000. A few systems that are designed for PCs and which use an underlying relational data base are now appearing to fulfill the need for integrated applications. Some are beginning to provide simultaneous access to their data for several users, like the mainframe and minicomputer systems.

ChiCor Information Management Inc.'s Communications Resource Management System operates on PCs and uses the DataEase relational data base to provide integration among eight modules. Rather than offering its own call accounting system, ChiCor provides users of its product with an interface that can import from and export to other vendors' call accounting systems.

SwitchView Inc.'s SwitchView software operates under Xenix and provides call accounting, Northern Telecom Meridian 1 station administration, and other modules for multiple users managing multiple sites. Xtend Communications' Notis messaging and Xtend CDR systems provide multiuser capability on several LANs. Communications Group Inc. has UNIX and MS-DOS LAN multiuser systems.

Isicad Inc.'s Command 2000 systems, which operate on PCs and UNIX computers, help users at one or several sites make decisions. They provide an overall look at which cable paths or pairs are available, in use, or not working, as well as a detailed view of individual network components. The software's graphical reporting capability provides a two-way link with data base information, so changes in the diagrams are reflected in the tabular information.

Quintrel Corp.'s CableTrak Data software, slated to be announced at the Communication Networks conference this month, will report about any path between data network devices, and between end-user stations and the network. The new data capabilities are options to the CableTrak Plant Cable and Wire Records module, which provides the central data base that integrates with call accounting, facilities graphics, directory, trouble reporting, service order, and line test interface modules.

It is easy to confuse integration with the less-powerful interfaces that are now common in this industry. In telemanagement, integration requires that a change or addition to any screen automatically update all related modules or subsystems. Also required are a common user interface from module to module or from application to application; conflict avoidance (the system rejects illogical or impossible orders or

requires that a human decision be made to resolve a challenge to a prior order); and automatic updates (changes in status, such as completion of a work order, automatically trigger a change or update). In contrast, multivendor systems--and some products from the same vendor--provide users with only an interface between functions.

New kinds of call accounting. By far the largest group of telemanagement products and systems are the 270 call accounting–related systems, services, and devices (see sidebar, "PC call accounting software leads market growth").

Call accounting systems report on phone calls made from or to an organization that uses a PBX, key telephone, or Centrex system. They collect SMDR call records from telephone systems, price the calls, and produce reports for internal cost allocation, client or guest chargeback, traffic analysis, personnel management, and system diagnosis.

This year the call accounting industry will be 20 years old. Rather than stabilizing, however, the 102 or so vendors in this segment continue to introduce new features and products at an unprecedented pace. Reflecting changes in equipment technology and network service offerings are features and products such as true network call accounting, low–end multiuser systems, automatic number identification (ANI), and Windows (see previous discussion of Windows applications).

Trak–A–Dial Telemanagement Software's PC–based Call Accounting software for true network call accounting consolidates multiple records for calls that travel through two or more nodes of a private network. This is in contrast to most multisite call accounting systems, which price calls from origin to destination and cannot perform pricing based on routing through multiple switches.

Low–end multiuser systems include NEC Technologies' line of UNIX–based systems. Introduced at the TCA show last September, this product line includes a desktop computer that sells for the cost of some PC software alone. And several vendors have introduced software that makes the use of ANI available in some areas. Complementary Solutions Inc.'s Telemate Plus module supports ANI records with an "alert **code.**" This **code** can be used to track calls such as those from competitors or former employees.

Big players join the game. With the exception of AT&T (which has marketed a continuous stream of call accounting products since the late 1970s), until recently the large well–known firms have shown little interest in being in the business of providing telecom management systems, software, and services.

But now, PBX manufacturers are becoming more active in offering telemanagement products. Northern Telecom contracted with Forte Advanced Management Software to build Meridian Manager, a multimodule system that it began shipping two years ago. Northern is so interested in using telemanagement capabilities to differentiate its Meridian 1 from other PBXs that it often provides the Meridian Manager Station Administration module at no charge to customers who buy a new switch.

Rolm Corp., the Siemens/IBM sales and marketing joint venture, has put significant dollars into building and promoting its Complementary Application Program, through which Rolm pledges to make unprecedented efforts to sell third–party software developers' programs. By June 1981, 10 telemanagement firms had been selected to join the program: The Angeles Group; Complementary Solutions;

Dynamic Communication Inc., Impact Technologies; The Info Group; Infortext Systems Inc., Instor Corp., Moscom Corp., TSB International Inc., and Xiox Corp. Also, IBM's NetView product line includes both call accounting and facilities management products.

In addition to these vendors, some of whose products compete among themselves, Rolm has added several other vendors whose products support CallPath and CallBridge, ANI, hotel property management systems, and other computer-to-telephone application interfaces. Mitel, Siemens, NEC, Fujitsu America, and Ericsson are all selling new systems for various telemanagement applications. Hitachi America Ltd. has long included a call accounting and on-line directory capability in its common equipment.

Electronic Data Systems, IBM, Siemens, and Westinghouse Communications Software are all vendors in this business. Their customers, while mostly large users, include firms with as few as 100 stations.

In addition to large firms, dozens of small competitors in the telemanagement industry have developed niche products--some earning only break-even results for several years. The benefit of this heated competition has been the introduction of better products, some of which have been breakthroughs in helping managers do their jobs better. On the negative side, some products might be orphaned as their suppliers fail, discontinue some packages, or choose to not support them.

PC call accounting software leads market growth

The U.S. market for call accounting systems exceeded $241 million in 1991, according to the report "Call Accounting Markets and Competitors 1991, " published last November by the Ergotec Group.

The strongest growth, in term of both revenues and number of systems shipped, was in PC software, sales of which increased to 14,900 systems valued at $64.3 million, according to the study.

The 332-page volume is the first of a two-part set to be completed this spring. The second volume, "Telemanagment Markets and Competitors 1991, " will provide detailed market information about telecommunications facilities management, directory and message center, network design, incoming call center, and related markets.

Daniel I. Stusser, voice applications editor of Networking Management, is the study's research director.

For more information about the study, contact the Ergotec Group at (206) 448-2000.

Daniel I. Stusser is the voice applications editor of Networking Management magazine and a noted specialist in telemanagement systems and markets. He is president of the Ergotec Group in Seattle, where he consults to industry vendors and users.

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Abstract

Electronic Tandem Switching (ETS) tandems can enable small business customers to queue calls to a distant branch on a single foreign exchange line. Or, in a more complex arrangement, many business–customer locations may be interconnected via one or more ETS tandems to form a nationwide private network called an Electronic Tandem Network. ETS makes calling simple and fast. This is largely because ETS incorporates a uniform numbering plan. With this plan, stations that are served by any of a company's PBX or centrex tandem locations –– referred to as " on– network " stations –– have seven–digit network directory numbers much like those used on the public telephone network. When a caller dials, the digital information that represents the called number is transmitted to an ETS tandem. The tandem collects the digits and then translates them to obtain the information it needs to route the call on the proper circuit. Uniform numbering eliminates the manual call routing procedures and complicated telephone directories required with some other private networks.

Full text

Electronic Tandem Switching offers business customers direct control over their corporate communications networks, least–cost call routing, and valuable administrative and engineering data.

When Bell Labs engineers and AT&T Marketing managers wanted to identify the features business customers want most in their private switching networks, they went right to the source. Working closely with corporate communications staffs from several industrial firms, Bell Labs and AT&T determined how the Bell System's new Electronic Tandem Switching (ETS) system could best meet business needs. The resulting operating, administrative, and maintenance features increase the usefulness of private business communications networks and encourage efficient management of the network facilities.

ETS features are available to customers through two kinds of electronic tandem switches: DIMENSION PBXs installed on the customer's premises, and No. 1 and No. IA ESS centrex systems located at Operating Company central offices.

Once again, electronic switching and stored program control prove their flexibility and help provide a wide range of capabilities. For instance, ETS tandems can enable small business customers to queue calls to a distant branch on a single foreign exchange line. Or, in a more complex arrangement, many business–customer locations may be interconnected via one or more ETS tandems to form a nationwide private network called an Electronic Tandem Network.

ETs makes calling simple and fast. This is largely because ETS incorporates a uniform numbering plan. With this plan, stations that are served by any of a company's PBX or centrex tandem locations referred to as "on–network" stations have seven–digit network directory numbers much like those used on the public telephone network. When a caller dials, the digital information that represents the called number is transmitted to an ETS tandem. The tandem collects the digits and then translates them to obtain the information it needs to route the call on the proper circuit. Uniform numbering eliminates the manual call routing procedures and complicated telephone directories required with some other private networks.

Other ETS features are designed to help keep communications costs down, while improving the versatility of the business telephone system. (A partial list of features appears in the panel, pages 246 and 247.)

Traffic efficiency features are especially important for cost control. The ETS tandem automatically selects the most economical path available for an off–network call; access to the public network may be via local access lines at the central office, WATS (Wide Area Telecommunications Service) lines, or foreign exchange facilities. In certain cases, the economical route to an off–network station is by way of a main PBX a PBX that "homes" on a tandem and that has its own local access lines. Thus the automatic route selection feature can bring the call as close as possible to its final destination before placing it on the public telephone network.

Because toll charges on the public telephone network vary with the time of day, the most economical route for a particular call also changes with the time. For instance, in the evening, when long distance rates are lower, it is more economical to use the toll network than it is to use WATS. The opposite is true during the day. ETS has three sets of programmed routing options for off–network calls. These programs can be changed automatically under clock control at each tandem.

On–network calls are routed to use network trunk groups efficiently. When a user calls an on–network station at a distant PBX, the automatic alternate routing feature causes the tandem to try up to three alternate routes if the first–choice trunk is busy. (For more about alternate routing, see the panel below.)

When all network circuits are busy, calls to on–network stations can be completed over off–network trunk groups; ETS will automatically convert the seven–digit private network number to a ten–digit public telephone network number. A tone signal will notify callers when their calls are about to take a relatively expensive off–network route.

Queuing is another traffic efficiency feature of ETS. If a call encounters a busy trunk group at a tandem, it is usually more efficient to delay the routing of the call or put it in queue in anticipation of an available trunk, rather than block the call and force the caller to try again. The strategy is to queue on the least costly trunk groups. If no trunk becomes available and the call waits in queue longer than some preset time limit, the call can advance to more expensive route choices. This puts the highest traffic loads on the most economical routes.

There are two queuing methods. With off–hook queuing, the caller stays connected listening to a recorded announcement or to music until a trunk becomes available and the call can be put through. With ring–back queuing, the caller hangs up and the tandem switch automatically calls back when a trunk is free to handle the call.

ETS permits calling privileges to be assigned to individual employees on the basis of job–related needs and responsibilities. Some users may be limited to calling only company locations, while others can call anywhere within certain geographical boundaries, when employees try to call numbers from which their stations are restricted, the tandem automatically responds with a signal–like an intermittent dial tone–that reminds the callers to dial company–assigned **authorization** codes. Unless a caller enters this **code,** the tandem will not complete the call. An **authorization cod**e much like a credit card number identifies the caller and thereby tells the tandem which facility options may be used to complete the call. By assigning **authorization** codes, company managers can restrict routine calls to less costly routes.

When a call is routed through more than one tandem on the network, the calling privileges of the employee placing the call are identified to the distant tandem or tandems by an electronic **cod**e called a traveling class mark. The tandem nearest the caller automatically sends the traveling class mark to ensure uniform handling at all the tandem locations through which the call passes.

ETS systems help with administrative tasks, too. A message–detail recording feature provides a complete record on magnetic tape of particulars on all calls through network tandems. This record includes such information as the calling and called numbers, caller **authorization code,** and the starting and ending times of the conversation. This information helps allocate the cost of calls to individual departments or employees.

Many businesses divide the costs of their private communications networks among clients or projects. The ETS recording feature facilitates this practice by accepting an account **cod**e which the calling party dials at the time the call is made. Later, the customer can process the data to obtain a complete report of communications expenses allocated to separate accounts.

ETS systems also report information that can be used in engineering and improving network facilities. The tandems provide hourly or peak–value traffic data for all trunk groups. These data include the number of completed calls, attempts, and "overflows" calls to on–network stations that are routed via the public network because of heavy traffic. The amount of usage for each trunk group and statistics on network queuing are also recorded.

The automatic circuit assurance feature also employs usage information to help detect potentially faulty circuits. For example, very short holding times on a circuit signal to the DIMENSION PBX tandem that callers are hanging up shortly after placing their calls, possibly in an attempt to get a better connection. When the holding time on a particular circuit consistently drops below a preset threshold, the tandem automatically alerts the tandem attendant to a potential trouble. Before ETS, attendants had to place calls manually over all outgoing trunks to make sure they were working properly.

Traffic data ultimately help business customers manage their ETS systems. For example, communications managers can use information on the status of facilities and traffic loads at each tandem to help them decide how to assign **authorization** codes, when to initiate or suspend

queuing on selected trunk groups, and how to vary call routing patterns.
Message-detail recording was a feature of earlier DIMENSION PBX systems which was enhanced for ETS. For No. 1 and No. IA ESS centrex systems, however, Bell Labs designed the new 93A Customer Premises System to store and print message-detail data at selected customer locations.
Customers have a choice of terminal arrangements for controlling access to ETS facilities. The method a customer selects depends on business needs and the size and 50-phistication of the network. The basic offering is a Customer Administration Panel (CAP) for DIMENSION PBX tandems, and a Local Customer Administration System dCAS) for No. 1 and IA ESS centrex tandems.
The CAP has a specially designed panel with push-button controls and a light-emitting diode display. The CAP plugs directly into the switching unit. Operating procedures allow customers to interact with both station features and ETS features.
The LCAS uses a terminal equipped with a line printer and keyboard. The terminal allows the customer to communicate with the ESS centrex at the Operating Company central office via a data set and a dial-up port.
Both the LCAS and CAP provide ETS system status information and allow the customer to control ETS features. The LCAS and CAP arrangements require that the customer analyze traffic data.
The Customer Administration Center System (CACS), on the other hand, helps the CACS operator to obtain and analyze data. The CACS is a stored program system which may be used with both the DIMENSION PBX tandem and with the No. 1 and No. IA ESS centrex tandems. Additional software enables CACS to operate with the ESS tandems by means of dial-up data ports.
CACS operators can interact with CACS from video display terminals, using English-language-like messages. Two CACS operators can obtain data and control ETS features in two different tandems simultaneously with the help of the CACS time-sharing capability. In addition, attendants can program CACS to poll traffic data from all network tandems automatically, and report the complete data, a summary, or exceptions to previously established limits.
Initial ETS service was begun in 1978 with a two-tandem network for the Olin Corporation. Since then, ETS has proven that it can handle the communications needs of a variety of business customers. Companies like Dresser Industries, United Technologies, Green Giant, and the American Broadcasting Company are planning to install ETS or are already putting it to work.
An example of alternate routing
An Electronic Tandem Network such as this one might link several branch offices of a large company. Dimension PBXs, No. 1 ESS centrex systems, and No. 1A ESS centrex systems provide Electronic Tandem Switching capabilities both to stations connected directly to them and to stations served by PBXs and centrex systems without ETS features.
In this example, a call originating at a station that enters the network at the San Francisco tandem, destined for a station served by the Philadelphia centrex, can travel several possible routes. The most direct and economical path (shown in color) is through the New York tandem. If all circuits are busy on this high-usage route, traffic will be sent on a less direct route by way of the Chicago tandem.
From Chicago, the first-choice route is the one-way bypass-access tie

trunk (dashed line). If a circuit is not available on this route, the call will travel from Chicago to the New York tandem, and then to Philadelphia. During routing, registers at each tandem location accumulate traffic data such as completed calls, incomplete attempts, and overflow calls. Message-detail data-including the identification of called and calling parties, the circuits used, and the duration of the call-are available at each tandem to help allocate facility costs and engineer the network.

Electronic Tandem Switching features and capabilities

GENERAL FEATURES

Station-to-station dialing: Any station served by the customer's network may be dialed directly from any other station on that network.

Uniform numbering: Each on-network station can be reached from any other on-network station with the use of a single seven-digit called number. Similarly, an off-network station is reached from any on-network station with the use of a single ten-digit called number. When dialing, callers precede the seven-digit and ten-digit numbers with an ETS access **code.**

Announcements and audible tones: Standard announcements and audible tones (examples include, "You have reached a nonworking number, " and the dial tone and busy signal) are provided to help ETS users.

Routing: Improved trunk efficiency is realized through automatic alternate routing for calls between company locations, bypass routing on one-way tie trunks for calls to selected distant locations, and automatic route selection for calls bound for the public network.

USER RESTRICTIONS

Authorization codes: The customer may require network users to dial an **authorization code** for specific calls.

Traveling class marks: Additional coded information is automatically sent between tandems to identify the calling privileges of a particular caller.

TRAFFIC EFFICIENCY

Time-of-day routing: Three automatic route selection patterns are available at each ETS tandem, any one of which may be activated at the appropriate time of day(o accommodate changing traffic loads and changing long distance charges on the public network.

Queuing: When the preferred and alternate routes are busy, calls can be placed on either off-hook or ring-back queue in anticipation of an available trunk. This puts the maximum traffic load on the most economical routing alternatives.

Overflow to off-network facilities: Calls to on-network stations may be routed to the public telephone network if no private network routes are available for call completion and the caller has the necessary calling privileges.

COST ALLOCATION

Message-detail recording at customer premises: A record of each call through each tandem may be prepared for internal billing and engineering.

Account codes: Dialed codes may be included in the message-detail records to identify projects or clients associated with calls.

Expensive-route warning tone: A tone may be applied on selected facilities to alert users that ETS is about to send the call on a relatively expensive route.

FACILITY DATA

Traffic measurements: Call attempts and usage data on trunk groups and queues may be polled by the customer.

Circuit assurance: Facility usage is monitored by the tandem and reported to the customer to ensure efficient use of trunks. The circuit assurance feature identifies trunks that may be defective and require testing.
CUSTOMER CONTROL AND STATUS
Customer Administration Panel (CAP): Customers can use the CAP to access data and initiate controls at DIMENSION PBX tandems. The panel has push buttons and a light-emitting diode display.
Local Customer Administration System (LCAS): With No. 1 and No. 1A ESS centrex systems, customers may use the LCAS keyboard-and-printer terminal to access data and initiate controls.
Customer Administration Center System (CACS): This processor-controlled system helps customers store, access, and analyze traffic and message-detail data. It also allows customers to initiate and schedule controls. The CACS is compatible with both DIMENSION PBX and No. 1 and No. IA ESS centrex tandems. When used with DIMENSION PBXs, the CACS also can perform certain rearrangements and changes on station lines.

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Abstract

The offices of modern high-tech businesses require greater communications flexibility than ever before. Further, businesses must find newer, more effective methods for reducing the costs associated with their communications. The SATURN family of telephone switching systems was designed and developed specially to meet these requirements.

Full text

The offices of our modern, high-tech businesses require greater communications flexibility than ever before. Further, businesses must find newer, more effective methods for reducing the costs associated with their communications. The SATURN®* family of telephone switching systems was designed and developed specifically to meet these needs.

Siemens, as the third-largest supplier of telecommunications equipment worldwide, and the largest supplier of private telephone switching equipment, established Siemens Information Systems, Inc. to develop viable products for the private sector of the US telecommunications market. 515 introduced several products, which eventually led to the development of the SATURN family of Electronic Private Branch Exchange (EPBX) digital voice/data systems. AU research and development of the SATURN systems was done at the 515 facilities in Boca Raton, Florida. The systems are manufactured at the company's Cherry Hill, New Jersey facility.

Structure and technology of the SATURN EPBXs

The SATURN family consists of state-of-the-art digital, stored-program systems that use pulse **code** modulation (PCM) and time division switching (TDS) techniques. The systems are capable of supporting a maximum of 992 ports (lines and trunks). Analog-to-digital and digital-to-analog conversion is provided by a codec per port. For analog devices, the codecs are located on the line and trunk cards; digital devices perform the conversion within the device. The non-blocking switching network system uses a single-stage time division architecture. The systems provide extensive business features previously found only in the largest private telephone systems, plus a number of new innovative features.

The smallest members of the SATURN family are the SATURN I (Fig. 1) and SATURN II systems, which serve up to 224 ports each. They are housed in single, small cabinets. The SATURN I system is unique in that it is delivered equipped with sufficient hardware and a default database to initially support 8 trunks, 16 standard telephones (rotary dial and/or tone dialing), and 8 Siemens digital telephones at startup. Only a minimal amount of customer database programming is required.

The SATURN IIE (Fig. 2) is another member of the SATURN system family. The basic system is housed in a single small cabinet which may be equipped with up to 480 ports; a small expansion unit may be added to the basic cabinet to expand the system to its full capacity of 992 ports.

The SATURN III provides up to 480 ports in a single cabinet; a second cabinet may be added to expand the system to its full capacity of 992 ports, and! or add a duplex common control. The complete SATURN family is shown in Fig.3.

SATURN features

Important design characteristics of the SATURN EPBX systems are:

*Universal ports

Any analog line or trunk card, or digital device interface card, may be installed in any available line/trunk card slot in the system.

*Modularity

Power supplies, equipment shelves, DTMF receivers, and memory cards

are added only as required.
*High traffic capacity
The SATURN systems are rated at 10,000 BHCA (busy hour call attempts), for a standard mix of station and trunk traffic and feature usage.
*Convection cooling
Due to their low power consumption and efficient equipment layout, the SATURN EPBXs do not require the use of forced air cooling fans. This, coupled with their ability to operate in a normal office environment, allows the systems to operate without a dedicated equipment room.
*Straightforward feature activation
While all SATURN features were designed to be easy to use, special care was taken to ensure that the following five most-commonly used features have straightforward activation: transfer, conference, hold, least cost routing, and internal call queuing (standby and call-back).
All of the SATURN systems have the same basic feature package, and can be programmed to accommodate customer features desired in a particular application. As an example of this flexibility, the system can be arranged to operate with attendant completion of incoming calls, DID (direct inward dialing), DIT (dedicated incoming trunks), or any combination thereof. The features are assignable as: system-level, station-level, trunk-level, attendant console-related, and maintenance. As customer requirements change, the various features may be assigned and/or reassigned among the users. When additional features become available, each system may be enhanced via easy-to-use customer memory update (CMU) procedures and/or new load program disks. In the following the features available in the SATURN systems are described.
Daytime trunk control
This feature restricts specific trunk groups from access by stations for outgoing calls during daytime operation, and restores access availability when the system is in night service mode.
Direct inward system access (DISA)
DISA allows an outside party to dial directly into the SATURN EPBX without attendant assistance, in order to gain authorized access to the SATURN EPBX facilities.
Direct inward system access - shared
This feature is identical in all respects to DISA, except that the trunk group serving this feature is shared between DISA and normal operation. When the trunk group is marked as DISA-S, calls to the special DISA number are handled as incoming calls as long as at least one attendant console is in operation.
Least cost routing (LCR)
The SATURN systems have one of the finest LCR packages in the industry. This feature provides the capability to route outgoing calls over the lowest cost route available at the time of call placement. The Siemens LCR feature provides several route selection criteria, including:
*LCR user priority levels,
*time-of-day and day-of-week route selection, .
*timed alternate trunk group advance,
*"look-back" route queuing,
*wide-band tone detection,
*dial tone detection, switchable dial pulse/DTMF signaling,
*specialized common carrier access, including equal access dialing, and

*standby and callback queuing.
Mobile **authorization** codes
This feature allows individuals to dial a special **authorization code** from any SATURN EPBX station and temporarily gain access to a preassigned class of service. This person can then place a call or activate a feature that otherwise would be restricted from that station. (Up to 2000 DISA or mobile codes may be provided in a SATURN system.)
SMDR account codes
This feature is used with SMDR (station message detail recording) on customer–selected incoming and outgoing trunk calls, and on customer–selected data calls, for such purposes as cost accounting or client billing. Default station account codes may be used; account codes may also be entered by the user on an optional or mandatory basis.
Station forced disconnect
A station, used with automatic answering equipment, can be provided with a loop current interrupt immediately after a calling party disconnect is detected, to prevent the equipment from remaining in a busy state.
Class–of–service blocking
This feature prevents stations or trunks assigned to a certain class of service from accessing others assigned to particular classes of service, thus preventing unauthorized toll calls, etc.
Uniform call distribution
This feature allows incoming trunk calls to have direct access to the longest idle station of a prearranged group of stations for answering without attendant assistance.
Voice mail interface
The SATURN systems have the capability to interface with a number of available voice mail systems, satisfying these objectives: to enable the calling party to gain direct access to the called party's voice mail box; to provide the calling party with the capability of transferring to the system attendant or to another system extension; and, to enable the called party's message waiting indicator.
The SATURN systems interface with conventional single–line telephones and the Siemens proprietary line of digital telephones. All of these instruments interface to the system through 8–port standard printed circuit boards without any port loss in the system. Additionally, a 16–circuit analog line interface card is available for the SATURN I and SATURN IIE systems. This card provides more concentrated packaging without port loss. The SATURN systems can be equipped for console or consoleless operation. Up to 12 attendant consoles can be provided, if required. Only a single wiring pair is required between all types of SATURN station instruments and the system.
The SATURN system offers two types of digital telephones for use with the base feature package. They are the JR–DYAD and the DYAD.
The JR–DYAD provides 16 line appearance and feature buttons, including eight fixed feature buttons: hang up (used for on–hook dialing release and on–/off hook for headset use) on–hook dial, store, speed dial, group pickup, redial, transfer/conference, and hold. The remaining eight buttons on the JR–DYAD, are programmable for additional feature activation or line appearances, as required.
The DYAD is available in 18– and 26–button versions, each of which has a 16–digit alphanumeric liquid crystal display and integrated speakerphone. The display is used to provide a variety of information to the station user, such as calling/called number, trunk group identification, calls–waiting indication, message waiting indication,

conference status, forwarded–to destinations, and time of day. All of the buttons are programmable for each station for either feature activation or line appearances, as required.

The DYAD may also be used effectively as an answering position for certain applications. For example, a DYAD could be used as the night answer position at a guard station, when the attendant consoles are in night mode.

The Siemens digital telephones offer the customer many new ways in which to use the SATURN systems. An extensive list of features is available for assignment to the feature buttons, including: direct (single–button) access to other stations, trunks, or trunk groups; intercom features; privacy features; call queuing features; call forwarding; conference features; hold features; and many others.

Physical architecture (Fig. 4)

Physically, all the SATURN systems are closely related. Most of the common control cards and all of the peripheral equipment cards, with the exception of the 16–circuit analog interface card, are ? exchangeable between the SATURN I, the SATURN II, the SATURN IIE, and the SATURN III systems. The basic differences in common control deal with input/output control, and are discussed below.

All SATURN systems are floppy disk based. Each system operates with two disks, and is delivered equipped with two floppy disk drives (FDD). All of the system software, plus the customer data base, is backed up on the disks. A complete load of the system from disk requires only about 2 minutes. The SATURN II and SATURN III systems operate with 8–inch disks; the newer SATURN I and SATURN IIE systems pack the same information onto 5–1/4" quad density disks.

The heart of each SATURN system is a 16–bit microprocessor serving as the central controller, which is responsible for all call handling, maintenance, and administrative functions. In the SATURN II and SATURN III systems, this is the Intel 8086; in the SATURN I and SATURN IIE systems, it is the Intel 80186. Resident paged memory for the central controller is provided on common control memory cards, each containing 1/4 Mbytes. A 1–Mbyte memory card is also supplied for the SATURN I and SATURN IIE systems, providing for more economical packaging.

The peripheral device scanning is done by a separate microprocessor, the SIB (signal input buffer) processor. The SIB processor scans every peripheral device, both analog and digital, and reports all input signaling state changes to the central controller through the SIB. The SIB processor generates an interrupt to the central controller when it has input signaling changes to report.

On the SATURN II system, one additional microprocessor termed the IOP (input/output processor) controls two RS–232–C ports and the two FDDs. On the SATURN III systems, two IOPs control four RS–232–C ports, the two FDDs, and, if the system has duplex common control, the HDLC cross–channel link to the hot standby side. Call processing status information is passed across this link so that, in the event of a failure on the active side that necessitates a control switchover to the standby side, stable calls (i.e. those in the talk state) will not be affected. Both the SATURN II and SATURN III systems provide a modem for remote dial–up access; the modem is cabled to one of the RS–232–C ports.

On the SATURN I and SATURN IIE systems, the FDDs are handled by the central controller as an additional task. The SIB processor also manages a single RS–232–C port. One additional microprocessor, the RAUP (remote access units/ports) processor, drives three additional I/O

ports: two RS–232–C ports plus the modem for remote dial–up access. In addition to serving as maintenance and administration ports, typical usages of the SATURN I/O ports are: real–time collection of SMDR records, and automatic on–line traffic metering and ACD (automatic call distribution) status reports. The SMDR package can produce records for voice only, data only, or both voice and data calls, and can, if desired, direct voice and data records to separate output ports.

In addition to the common control processors described above, each digital peripheral device in the system is microprocessor firmware–controlled. These include the attendant consoles, the JR–DYAD, the DYAD, and the Siemens DCI (data communications interface). The digital telephones and the DCIs are interfaced to the system by the same 8–circuit digital interface card.

Software architecture

All of the database and all of the software is resident in system memory, except for the CMU (customer memory update) routines, which are brought into resident overlay zones from disk as needed for database administration. Most of the **code** is written in CHILL (CCITT high–level programming language), except for real–time critical procedures which are coded in Assembler language for maximum efficiency.

The operating system is process–priority oriented and interrupt–driven; it gives control to the highest priority active process with events waiting whenever a context switch occurs. This will normally happen at least every 4 ms, since the system derives all software timing via a 4–ms periodic interrupt. Events to a process may be generated internally (from a process) or externally, via an interrupt.

The call handling process is strictly state–event driven. Every call processing event is first directed to a step table for that device type. For example, there are unique step tables for stations, trunks, attendant consoles, DCIs, and for each type of special equipment handled, such as dictation, paging, and recorded announcement circuits. The step tables themselves are written at a high level, and hence are kept less volatile, by adherence to the standard that step tables are not allowed to access the database.

Access to the database is provided by more specialized lower–level routines called CRs (common routines) and FRs (functional routines). The CRs perform a specific function; FRs also perform a specific function, but above that return a result, which controls the flow of the calling logic. For example, the logic sequence shown in the Table might be encountered in the station step table during the processing of an off–hook event for a DTMF station in the idle state.

This employment of a top–down approach, not just in the design process but in the **code** itself, results in a structured software base that is easier to learn and understand, and consequently one that is easier to modify and debug.

Another interesting concept used in the SATURN software design area is the use of public modules; that is, individual designers do not have responsibility for particular modules. All modules are the public domain of the entire SATURN software design team. This is important from the standpoint of design efficiency. Enhancements are made to the software on a feature basis, and features invariably cross module boundaries. Designers are assigned responsibilities for features, not modules, so each can work at maximum efficiency, not necessarily having to wait on others at key points. Careful logging of changes and careful configuration management, plus extensive regression testing at each release cycle, much of it automated, make this approach possible.

Finally, one of the most important design goals of the SATURN family was to keep as many modules as possible common among the systems, including all of call processing. This was accomplished, guaranteeing the customer that the SATURN systems represent a true family with identical feature content. This keeps the software manageable by ensuring that the most volatile part of the systems is common.

Additional feature packages

In addition to the basic SATURN feature package, numerous sophisticated feature packages are available, and more are under development. Additionally, an automatic database upgrade package is available to those customers who wish to easily upgrade their system to a later software version containing new, desired features. The major feature packages available today are highlighted below.

Office communications II (OC II)

This is the asynchronous data package for the SATURN systems, providing switched data at up to 19.2 kbit/s over single twisted-pair wiring. Data ports are interfaced to customer-provided data terminals, modems, printers, and host computers using the DCL. Data calls may be originated by terminal dialing, with extended text or CCHT standard progress messages. A terminal or printer can also be associated, via database programming, with any type of station (regular telephone, DYAD, or JR-DYAD), and both voice and data calls can then be originated from the station. Voice calls can exist simultaneously with data calls; a voice call can also be switched over to data by the station user. Powerful data features are provided: automatic pooled modem selection, automatic data speed adjustment, standby queuing with queue position notification, pilot number access to data line groups, and warmline, hotline, or nailed-up connections. Additionally, many of the applicable voice features, such as LCR (least cost routing), speed calling, last number redial, and class-of-service blocking, are available to the data user.

Centralized attendant service (CAS)

A complete CAS package is offered with SATURN II, IIE and III, allowing multilocation businesses to centralize attendants at a single, main location. Each branch location has its own EPBX and its own LDN (listed directory number). Trunks called RLTs (release link trunks) are used for the short holding time CAS calls between the main and branch locations. The CAS attendants handle incoming calls to LDNs, attendant calls from branch stations, recalls from branch stations, and calls transferred to the attendant from branch stations. Not all EPBXs in a CAS system must be of the SATURN family. A SATURN switch can serve as either the main or a branch node. It will interface with any other EPBX conforming to AT&T Technical Publication 42715, "Interface Criteria for Centralized Attendant Service."

Main-satellite service (MS)

The use of MS service (not available on SATURN I) allows a company with multiple locations to function as one, providing the users with transparency of most features among the switches. One of the SATURN systems (nodes) serves as the main; the remainder are satellites of the main. The trunks connecting the satellites to the main are called MSLs (main satellite links); a proprietary signaling protocol is used to pass call control and call status information over the MSLs. Sophisticated call-handling software ensures that the number of MSLs used on a call is minimized. For example, a call placed from a station in one satellite to a station in another satellite switches through the main, using two MSLs. If the call is then transferred back to a third station in the originating

satellite, two more MSLs are used. However, when the transfer is completed, all four MSLs are released, with the switching reestablished internal to the originating satellite.

A typical MS installation has all attendants and trunks concentrated at the main to consolidate facilities, although this arrangement is not mandatory. For customers requiring both CAS and MS features, both feature packages can be combined.

Digital trunk interface (T1)

For every SATURN T1 span used, each of the 24 channels can be assigned to function, in any combination, as a CO trunk (ground start, loop start, or DID), a tie trunk (E&M 2– or 4–wire, including MSLs and RLTs), or an OPS (off–premises station). When used in networking and central office trunk applications, the SATURN T1 interface allows direct digital connection to customer– or telco–provided T1 facilities. It can operate in the standard or extended framing format modes, and can handle the clear channel variant known as "B8ZS."

The SATURN T1 interface meets the requirements established by FCC docket number 81–216, and meets the DS–1 standard for the T1 digital span; it is compatible with D1D, D2, D3, or D4 channel banks. The interface also meets the 1.544–Mbit/s high–capacity digital service as defined in AT&T PUB–62411. In fact, a T1–equipped SATURN system was the first EPBX to undergo and pass AT&T Bell Laboratories T1 compatibility testing, and consequently Siemens became the first EPBX manufacturer to be placed on AT&T Communications' list of approved interconnect vendors. The SATURN T1 interface is available on SATURN II, IIE and III.

Automatic call distribution package A (ACD–A)

The ACD–A package provides several enhancements to the SATURN base UCD feature. Three different ACD announcements can be provided: mandatory first announcement or first delay announcement, second delay announcement (one–time or cyclic), and night announcement. For each ACD group, one or more of the agent positions may be designated as supervisory positions. The supervisor, using a DYAD, can perform all normal agent functions, and additionally can control the time value to the second delay announcement and can place the ACD group in night mode. When in night mode, all incoming calls to that ACD group may be directed to another ACD group, to the attendant console, or to one of the system night answer positions if the attendant console is not provided or is unstaffed. An online ACD status report is also provided, periodically outputting a current "snapshot" of the activity in each ACD group (total agents available, unavailable, busy, ringing, idle; number of trunks queued).

Shared tenant service (STS)

The STS feature package permits building operators to take advantage of regulatory changes which allow the resale of communications services (local and long distance) to their tenants. This feature allows the owner to functionally subdivide the SATURN system, giving each tenant the appearance of a dedicated EPBX system. This is accomplished by assigning stations serving the tenant to a "tenant group." Similarly, attendant consoles are assigned to "console groups, " which are associated with specific tenants. Incoming calls may be routed to consoles dedicated to the tenant, consoles shared with other tenants, or system consoles operated by the building owner. Similar flexibility is available with respect to outgoing calls. In addition, tenants may share any or all of the features and facilities of the SATURN

system. Inter-tenant blocking of internal calls may be enabled if required by local tariffs. SMDR reports, coupled with VFACs (verified and forced account codes), provide a means of accurate billing of tenant calls.
There is also a health care package, which provides the SATURN system with an additional feature complement specially designed to meet the communication needs of the health care market.
The SATURN family of EPBX systems provides a wide latitude of flexibility in station, trunk, and feature assignments. The systems truly provide the full capabilities required by today's typical business office, yet already provide many sophisticated features for tomorrow's office.

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Abstract
To help corporate network customers more fully exploit the public network and its advantages, BNR has developed a portfolio of advanced business services for Northern Telecom's DMS-100 Family of digital switches. Based on Common Channel Signaling System number 7 (CCS7), these services marry the functionality and control of private networks with the inherent advantages of the public network. As a result, operating companies can offer their multilocation corporate customers a number of attractive

alternatives to private network solutions. The first two services offered by Northern Telecom in the new business services portfolio are Area Wide Centrex (AWC) and Private Virtual Networking (PVN). Both are supported by DMS–100 Family switches and are built on Northern Telecom's Meridian Digital Centrex.

Full text

Evolution in business networking

BNR and Northern Telecom share a vision with telecommunications operating companies a vision of an increased role for the public network in providing communications services to businesses. To help realize this vision, BNR has developed a portfolio of advanced business offerings, based on CCS7, that will provide multilocation business customers with a wider range of services from the public network.

Large multilocation corporations typically the heaviest users of communications facilities and the largest contributors to operating company revenues have increasingly been turning to private networks to carry telephone traffic between their locations. Although private networks can offer a number of advantages that until now have not been available from the public network, businesses that rely solely on private networks often forfeit advantages offered by the public network. For example, the public network provides a level of reliability, convenience, and ubiquity generally not practical to achieve in private networks, and it enables customers to take advantage of the latest technology and service enhancements without incurring capital expenses. Moreover, public network offerings, in certain situations, can cost less than alternative private network solutions.

To help corporate network customers more fully exploit the public network and its advantages, BNR has developed a portfolio of advanced business services for Northern Telecom's DMS–100 Family of digital switches. Based on Common Channel Signaling System number 7 (CCS7), these services marry the functionality and control of private networks with the inherent advantages of the public network. As a result, operating companies can offer their multilocation corporate customers a number of attractive alternatives to private network solutions.

Developing the new portfolio of CCS7based services is an approach consistent with the belief held by BNR and Northern Telecom that some capabilities are best provided by the public network, and that the greatest benefits to the customer are realized through hybrid networks of both public and private elements. As a result of this belief, the new BNR–developed CCS7based services are key elements in Northern Telecom's Meridian Customer Defined Networking (MCDN) framework. MCDN, through its building blocks of products, applications, and support tools, gives systems integrators and their customers the flexibility to configure hybrid networks optimally from a variety of vendors' products and multiple carriers' services. (For more information on MCDN, see p. 8.)

The first two services offered by Northern Telecom in the new business services portfolio are Area Wide Centrex (AWG) and Private Virtual Networking (PVN). Both are supported by DMS–100 Family switches and are built on Northern Telecom's Meridian Digital Centrex the most advanced digital Centrex product in the world.

Area Wide Centrex

The first service, Area Wide Centrex, enhances Meridian Digital Centrex by extending across the network those features that up to now have been limited to lines served by a single switch. In addition, AWC allows nodal functions, such as attendant services, to be consolidated at a single location or, in the case of automatic call distribution, to be

better coordinated among locations.
Without AWC, today's Sophisticated Centrex switches are essentially feature islands, supporting hundreds of station and system features on an intraswitch basis only.
To achieve networkwide extension of features, AWC employs either the ISDN User Part (ISUP) or Transaction Capabilities Application Part (TCAP) signaling protocols of CCS7, depending on the feature. (For more information on TCAP and ISUP, see the article on p. 14.)
Feature transparency across the network offers a number of benefits to multilocation business customers, including:
* operational cost savings, with features such as network attendant services;
* higher call-closure rates, with such features as network ring again;
* improved control over communications costs, with features such as network station message detail recording (SMDR);
* higher service load without increased operational costs, with such features as networked automatic call distribution; and
* improved, cost-effective methods of serving branch offices and small-line locations of corporate customers, especially when used with PVN.
In turn, AWC enables operating companies to maintain Centrex as an alternative to increasingly Sophisticated private branch exchanges (PBXs) that support networked features. In addition, because of the enhanced value of Centrex to many customers, operating companies have an opportunity to increase revenues from their existing Centrex customer base. Diagram A in Box 1 shows AWC applied to a Centrex-based corporate network. As the diagram illustrates, AWC can also be extended to PBXs in the customer's network via the ISDN primary rate access (PRA) interface.
The success of advanced AWC station features, listed below, is highly dependent upon the terminals that support them. BNR and Northern Telecom are committed to providing business terminals that maximize ease of use, and therefore enhance the value of advanced business features. Northern Telecom's Meridian Business Sets can display not only the caller's name and number, but other call-related information as well, such as the reason why a call has been forwarded and by whom. The new M5317T ISDN terminal, with its liquid crystal display and feature-assignable hardkeys and softkeys, also complements the AWC station features. (For more information on business terminals, see p. 40.)
The initial AWC station and system features on DMS-100 Family switches include:
* Network number display. With this feature, the called station displays the calling number in the form that the called party would dial to reach the calling party. For example, if the call is between two on-net stations, the number displayed would be the private number of the calling party, complete with any prefix digits needed to place the call (Figure 1).
* Network name display. In addition to the basic calling number, this feature also displays the name of the person or organization associated with the calling line (Figure 1).
* Network ring again (NRAG). NRAG extends the single-node ring again feature to lines on other switches, complete with the existing nodal queuing functions.
* Network attendant services (NAS). NAS allows a customer to designate one or more of the Centrex switches in the private network to provide full attendant services for any line on any other switch.

* Networked automatic call distribution (NACD). NACD extends the existing Meridian Digital Centrex automatic call distribution feature to all nodes in a customer's network.

This last feature, NACD, is expected to be of particular interest to multilocation corporate customers. The existing Meridian Digital Centrex automatic call distribution (ACD) feature supports the overflow of incoming calls from one ACD group to another on the same switch, or to another switch over predefined routes. (The customer can define when calls will overflow to another group, by specifying both the number of calls that can be queued and the maximum anticipated waiting time for incoming calls.) However, without NACD, there is no guarantee that the ACD group to which a call is rerouted is better able to handle the call.

By contrast, implementation of NACD provides more intelligent distribution of calls between ACD groups. NACD enables real-time load balancing between ACD groups and individual ACD agents, by constantly monitoring the network load condition and resource availability. Because each ACD group is aware of the traffic condition of every other ACD group, a call that comes into any group can be rerouted to the group that is best able to handle the call, taking into consideration the cost of rerouting.

In theory, NACD could be used to create a single ACD group comprising agents on different switches. However, for administrative and engineering reasons, it is expected that NACD generally will be used to better coordinate a number of ACD groups, with one or more groups on a given switch.

A typical application for NACD would be an airline, where different ACD groups handle general inquiries, reservations, and flight information. Each group of agents would be set up as an ACD group, reached by a different public telephone number. If one group were unable to handle a specific volume of incoming calls, as defined by the customer, NACD would reroute new incoming calls to the ACD group best able to handle the additional volume.

The NACD feature can also be used for many other applications, such as distributing incoming public or private calls to customer-provided agents, or distributing outgoing telemarketing calls to agents. Within BNR, NACD is being used as an implementation platform for other features that require the queuing and call distribution functionality NACD provides. Examples include network voice messaging service and network attendant services.

Private Virtual Networking

Like AWC, Private Virtual Networking (PVN) improves the business efficiency of multilocation corporations. These corporate customers typically choose private facilities (such as tie trunks) to route their on-net and off-net traffic when the alternative of routing this traffic over the public switched network is more expensive. Businesses may also be attracted to private facilities because networks based on these facilities can provide functionality that has not been available in the public switched network, such as abbreviated private numbering plans and the ability to recognize an incoming call as being on-net.

To better address the corporate network market, public network providers have started to offer virtual private network services. Although virtual private network calls are carried over the public network, these services generally are priced lower than standard toll calling. Lower pricing is possible because the services provide tariffing flexibility, as discussed below.

BNR has developed PVN on DMS–100 Family switches to allow operating companies to offer their multilocation business customers virtual private networking. PVN, therefore, is both a software implementation supported by DMS–100 Family switches, and a tariffable operating company service.

The two key features of PVN are shared trunking and centralized network management. The first of these shared trunking provides the capability to carry on–net calls on the same physical trunks as the on–net traffic of other customers, or even public traffic, and still retain the on–net identity of the calls.

For multilocation business customers, shared trunking offers several advantages. For example, through shared trunking, PVN can extend cost–effective private network access to those business locations that cannot justify interlocation private facilities or dedicated access to a private network. These sites are usually remote locations or ones that do not generate high volumes of traffic, such as those with only a few single–business lines or a key telephone system. Although these locations can today access private networks using the public network, callers generally must dial a local or toll access number and enter an **authorization code** before dialing the actual destination number.

With PVN, however, remote locations can benefit from virtual on–net calling, which enables callers to place an on–net or off–net call in exactly the same manner as callers directly connected to the private network; that is, by dialing a prefix digit followed by the destination number. This virtual on–net calling is expected to be a major application of PVN.

Shared trunking offers customers additional advantages, including:

* public network reliability and performance for on–net calling;
* fast provisioning of virtual facilities as traffic patterns change (or, alternatively, the customer's traffic may simply be carried over the public switched network without requiring customers to engineer their interlocation facilities);
* improved budget control because the PVN serving switch can record the calling numbers of Centrex and single–business lines on subtending switches, allowing PVN calls to be billed back to the originating line. Public network switches acting as nodes in a corporate network (Centrex for example) usually do not receive the calling number from subtending switches.

Shared trunking benefits not only operating companies but business customers as well. For example, shared trunking allows operating companies to establish new tariff structures for public switched network services targetted at their multilocation business customers, and therefore provides tariff flexibility. On–net calls carried over shared trunks can be charged on a usage–sensitive basis or as lower–priced, flat–rate virtual private facilities both attractive options to muttilocation businesses, depending on traffic volumes.

Shared trunking also allows the operating company to reduce its costs. The operations, administration, maintenance, and provisioning (OAM&P) costs associated with operating–company–provided trunks utilized by many customers are less than for trunks dedicated to a single customer.

Virtual private networking appeals especially to customers experiencing rapid changes in their corporate networks. Therefore, consistent with the rapid provisioning that shared trunking allows, the other key feature of PVN is the ability to centrally administer customer

screening, translation, and routing data. This capability enables operating companies to respond to customer requests as efficiently as possible and to offer customers the ability to access and modify their own data directly, without involving normal operating company service order procedures.

In both cases, this centralized network management capability means businesses can achieve tight cost controls as well as fast network provisioning. They can easily alter routing data, thus achieving low transmission and OAM&P costs.

This capability has been developed by enhancements to DMS-100 Family switches, which allow many of the screening, translation, and routing functions provided by Meridian Digital Centrex to be migrated to a centralized database, referred to as a service control point (SCP). The DMS-100 Family switch that interacts with the SCP on a per-call basis, using the CCS7 TCAP protocol, is referred to as a service switching point (SSP). This intelligent network architecture is shown in Figure 2. An example of an actual PVN call is presented in Figure 3.

One example that demonstrates the value of this intelligent network architecture is **authorization code** administration. Today, **authorization** codes controlling calling-party privileges (access to toll networks, for example) must be stored and maintained in a number of switches in the customer's network. In the case of Centrex, the codes usually are updated via operating company service orders. With PVN, however, the **authorization** codes can be stored solely in the SCP. As a result, an operating company can offer its customers the ability to update their **authorization** codes for all locations directly and easily in the SGP, without involving the operating company.

An additional advantage of the intelligent network architecture is that it allows operating companies to provide uniform service across a multivendor network. Because PVN enables screening, routing, and translation functions to be provided by the SCP, customers served by central office switches from different manufacturers can receive seamless, networkwide PVN service. Diagrams B, C, and D in Box 1 show several ways customers can configure their corporate networks using PVN service.

The DMS PVN-SSP supports PBXs and single-business lines (including key telephone systems), as well as Centrex lines. With the SSP capability, the SCP can serve all lines in a customer's network. Consequently, although PVN-SSP functionality has been built on Meridian Digital Centrex software, it is expected that operating companies will offer PVN independent of Centrex service. In fact, PVN customers may very well have no Centrex lines in their networks.

Because the DM5 PVN-SSP supports in-band multifrequency (MF) trunk signaling, PBXs do not require any design modifications to utilize PVN functionality. PVN can also interface to PBXs by using primary rate access (PRA). Furthermore, SUP trunk signaling can be used to interconnect PVN-SSPs and other public network switches. Support of PRA and ISUP will result in improved performance and functionality (for example, post dial delay will be reduced) and will exploit the synergy between PVN and AWC.

Services synergy

BNR is developing the entire portfolio of CCS7-based DMS-100 Family business network services to be highly synergistic with one another and with existing nodal services. PVN and AWC are the beginning. This strategy supports Northern Telecom's expectation that these services, and others developed in the future, will be combined and marketed in

both operating-company-specific and customer-specific applications. In other words, operating companies can combine individual capabilities to meet their needs, and corporate customers can do the same.

For example, because PVN is compatible with existing multifrequency signaling, it can be used in corporate networks that do not support AWC. Similarly, AWC can be used between corporate network Centrex switches that do not utilize PVN. However, a single corporate network can synergistically use both PVN and AWC. For instance, AWC station features, such as network ring again, and system features, such as network attendant services, can be activated for PVN calls, including those carried by PVN shared trunks. This kind of interaction allows full private network functionality to be extended to a wide variety of business types and locations. Diagram E in Box 1 provides an example of bow customers can use AWC and PVN together in their corporate networks.

Implementation

BNR engineers have achieved the required synergy between existing and new services by building the new CCS7-based business network services on a common base. This base consists of the world-leading Meridian Digital Centrex software, as well as the CCS7 signaling protocol base and SSP functionality already implemented on DMS-100 Family switches. The common base facilitates the development and deployment of new services. (For more information on BNR's layered approach to CCS7 implementation, see the article on p. 4.)

To support PVN functionality on DMS switches, for example, BNR enhanced Meridian Digital Centrex call processing to give it the capability to:

* access PVN by Meridian Digital Centrex lines and single business lines on the SSP; * access PVN by dedicated and shared trunks from central offices and PBXs, using existing private network muttifrequency (MF), dual-tone multifrequency (DTMF), and dial-pulse (DP) signaling or Feature Group D multifrequency signaling;
* query the PVN-SCP during call processing, accept its response, and handle the call according to instructions in the response message;
* enable the SSP to prompt the caller to enter an **authorization code** in response to a request from the SCP;
* provide additional billing functionality for PVN calls; and
* send call termination information to the SCP indicating the duration of the call and the way it was handled.

Because the new PVN functionality uses existing Meridian Digital Centrex (MDC) call processing as a base, several interactions between the two are ensured, providing corporate customers with even greater benefits. For example, the software implementing the PVN-SCP query is invoked from the MDC feature processing environment to allow interaction with existing MDC features. Features that interact with PVN include call-forward-busy, call-forward-don't-answer; three-way calling, call transfer, pre-set conference, station controlled conference, and last-number redial.

In addition, MDC attendant console software allows MDC attendants to function as PVN attendants. Among other services, these attendants can provide dialing assistance, originate and extend PVN calls, and assist in entering **authorization** codes and personal identification numbers. PVN also employs the existing MDC feature processing environment utilities to collect **authorization** codes and to enable experienced users to terminate prompts by entering the first digit of the **authorization** codes.

Further examples of the synergy between MDC and PVN include the direct inward system access (DISA) feature of MDC, which provides remote access for PVN callers; and the Meridian Digital Centrex WATS routing feature, which supports completion of calls to WATS facilities when specified by the PVN-SCP Additionally, to introduce PVN into a private network or to extend the geographic coverage of an existing private network, MDC translation and routing schemes can treat PVN calls as one of the items in an automatic route selection list.

To ensure the compatibility of CCS7-based business network services on DMS switches with network products of other manufacturers, BNR is actively involved with Bell Communications Research Inc. (Bellcore), telecommunications operating companies, other equipment manufacturers, and standards-setting organizations in developing service specifications and signaling protocols. For example, the DMS100 Family PVN-SSP implementation is based on the Bellcore specification TR-TSY-000402, Additional Service Switching Point and Related End Office Capabilities (including Private Virtual Network Services). BNR is working with these same groups to establish similar specifications for Area Wide Centrex.

In addition to its involvement in these ongoing programs, BNR participates in lab-to-lab trials to expedite successful service deployment where Northern Telecom products must interface with products from other manufacturers. This year, for instance, BNR conducted joint lab-to-lab trials with Bellcore and verified compatibility between the DMS-100 Family PVN-SSP and the Bellcore PVN-SCP.

AWC and PVN only a start

BNR and Northern Telecom are helping multilocation business customers build hybrid corporate networks with the optimal mix of private and public elements. Area Wide Centrex and Private Virtual Networking services are the first in a portfolio of synergistic CCS7-based business network services offered on DMS switches that will help operating companies realize their vision of an increased role for the public network in providing communications services to these customers.

These services, however, are only a start. As operating companies continue to deploy CCS7 to interconnect more of their network elements, increasingly advanced capabilities, such as public dialed number portability, will become available. BNR has already established its leadership in business network services by building AWC and PVN on existing DMS-100 Family switches, Meridian Digital Centrex, and CCS7 bases, and will continue to be at the forefront of the industry in developing other component services in the operating company's area-wide business networking portfolio.

Mike Davis graduated from McMaster University (Hamilton, Ontario) in 1983 with a B.Sc. in computer science. He joined BNR that same year to work in the local/toll call-processing area of central control software development for DMS-100 Family products. In July 1986, Mr. Davis was promoted to his current position as manager, local/toll area, within the network services development group.

David Hudson is currently assistant vice-president, network services development. After completing his B.A.Sc. in engineering science in 1973 at the University of Toronto, he was hired by Northern Telecom to work on the SP-1 switch. He joined BNR in 1980 as a member of the DMS-100 Meridian Digital Centrex development team, and was soon promoted to manager, responsible for attendant console

development. In 1983, Mr. Hudson was transferred to field support to handle the introduction of Meridian Digital Centrex into the Bell operating companies. A year later, he took up the position of project manager, responsible for Meridian Digital Centrex and POTS call-processing development, and in 1986 was promoted to group manager, responsible for DMS network services.

Chris Thompson, manager, business network services deployment, has been involved in numerous projects during his career at BNR. He joined the company in 1978 as a service planner in the systems division, working on Bell Canada programs, including videotex, pay-TV billing, subscriber services system, public telephony, and CCS7-based services. In 1985, he was promoted to do near-term DMS product planning for Northern Telecom, where he has been involved with such major projects as ISDN primary rate access, feature networking, and private virtual networking. Mr. Thompson received his B. Eng. (electrical), with distinction, from Carleton University (Ottawa) in 1973.

Area Wide Centrex extends across the network those features that have been limited to lines served by a single switch

The two key features of Private Virtual Networking are shared trunking and centralized network management.

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